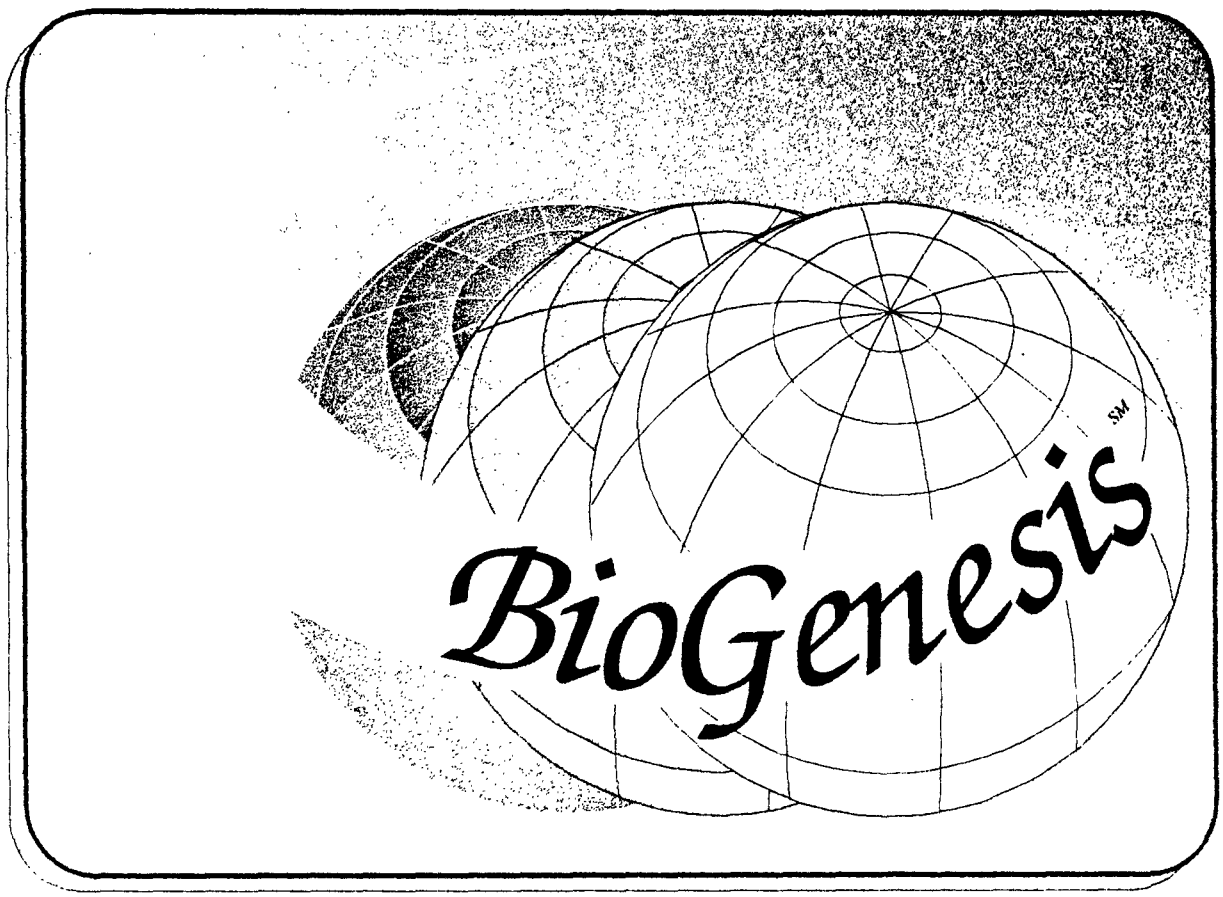
BENCH SCALE TREATABILITY STUDY REPORT:

DECONTAMINATING DREDGED ESTUARINE SEDIMENTS

PERFORMED BY BIOGENESIS ENTERPRISES, INC.
FOR THE BROOKHAVEN RENSSELAER ENVIRONMENTAL PARTNERSHIP MULTISTATE ALLIANCE

CONTRACT No.: 725044



... Cleaning Today for Tomorrow™

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Submitted by:

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8 February 1996

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ABSTRACT

The BioGenesis℠ Sediment Washing Process was chosen by Brookhaven National Laboratory to perform a treatability study on dredged estuarine sediments from the New York/New Jersey Estuary (Harbor). This treatability study was used as a preliminary evaluation of the BioGenesis technology for decontaminating harbor sediments to maintain harbor navigation in an environmentally-acceptable, cost-effective manner. The analytical results stemming from the bench test proved inconclusive regarding the extent of both initial contamination and the removal efficiency of the cleaning process. BioGenesis presents possible reasons for the inconclusivity of the results, as well as direction for the next phase of testing. The technology has proven effectiveness on PAHs, PCBs, TPH and inorganic contaminants and should be considered a viable solution to the contaminates in the New York/New Jersey Harbor. This report details the bench-scale treatability study process, lists the difficulties associated with interpreting the analytical results, and points to a solution for the proper implementation of the technology.

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I. INTRODUCTION

BioGenesis Enterprises, Inc. (BioGenesis) was awarded a contract by Brookhaven National Laboratory (Brookhaven or BNL) to perform treatability testing for decontaminating dredged estuarine sediments from the New York/New Jersey Estuary (Harbor). This contract was awarded by Brookhaven in support of the U.S. Army Corps of Engineers, New York District (COE/NYD), the U.S. Environmental Protection Agency, and the U.S. Department of Energy to evaluate technologies for decontaminating dredged sediments which contain aromatic hydrocarbons (PAHs), organochlorines (such as dioxins, furans), polychlorinated biphenyls (PCBs), chlorinated pesticides and herbicides.

The objective of this treatability test was to evaluate the BioGenesis℠ Soil and Sediment Washing Processes for the treatment of contaminated estuarine sediments found in the harbor. This evaluation provides enough information to develop cost estimates and provides data necessary to establish a reference for selection of the BioGenesis℠ Soil and Sediment Washing Process for pilot-scale testing.

Summary results and discussion are provided in the body of this report to identify the potential for scaling-up the BioGenesis technology to pilot-scale. Included are the processing rates, space, utility, personnel and other resources needed to operate the technology at the pilot-scale. Environmental, health and safety impacts and issues created by scaling-up the system are included with available permitting information, end product management, pre-treatment requirements, pilot-scale plans and a schedule for implementation. Costs for capital, operating, unit sediment treatment, maintenance, and disposal at the pilot-scale are provided as stipulated in the SOW requirements for the bench-scale treatability study report.

I. a. Background

The sediments in the New York/New Jersey Harbor (Harbor) must be routinely dredged to maintain navigable water depths for shipping channels and berthing areas for commerce and safe navigation. Ocean disposal has historically been used as the primary alternative for disposal of dredged materials. The sediments that accumulate in the Harbor may contain contaminants such as organic compounds and heavy metals, frequently at concentrations high enough to prohibit direct ocean disposal or beneficial use.

Dredged sediments must pass testing criteria prior to unrestricted ocean disposal. The recently revised regional guidance, *Guidance for Performing Tests on Dredged Material Proposed for Ocean Disposal* (Draft December 1992), has established more stringent biological and chemical test criteria As a result, the volume of contaminated dredged material potentially prohibited from unrestricted ocean disposal may increase. The volume of contaminated dredged material has been estimated and is given below:

CATEGORY 2	3.1 MILLION CUBIC YARDS PER YEAR
CATEGORY 3	1.6 MILLION CUBIC YARDS PER YEAR

Where "CATEGORY 2" material is defined as that material which has been tested and does not indicate significant toxicity but does not meet the criterion for unrestricted ocean disposal. This material may be suitable for ocean dumping with capping, disposal at a landfill or disposal in a containment facility. "CATEGORY 3" material is defined as that material which fails acute toxicity testing and does not meet the criterion for ocean disposal.

The U.S. Environmental Protection Agency, Region II (EPA) and the U.S. Army Corps of Engineers - New York District (COE-NYD) are actively seeking and investigating sediment decontamination technologies for dredged material management. Section 405 of the Water Resources and Development Act of 1992 authorized an investigation, including testing and demonstration, of decontamination technologies and their potential application to contaminated sediments to maintain harbor navigation in an environmentally acceptable, cost effective manner.

Dredged sediments from various areas of the Harbor contain elevated levels of one or more of the following contaminants: heavy metals, polynuclear aromatic hydrocarbons (PAHs), organochlorines (such as dioxins and furans), polychlorinated biphenyls (PCBs), chlorinated pesticides and herbicides. These contaminants are hazardous to human health and the environment and must therefore be removed from the dredged sediment before further disposition, either by ocean disposal or by alternative, beneficial disposition.

The economic impact resulting from the inability to dredge the ports in the New York/New Jersey area is estimated to total $21,000,000,000 and affects both directly and indirectly nearly 200,000 jobs.

II. TREATABILITY TEST PROCEDURE

The sediment sample collected for the treatability test was collected on October 11, 1995, aboard the Army Corps of Engineers Survey Vessel *Gelberman.* A total of about 275 gallons of sediment were collected using a modified clamshell dredge of about 0.2 cubic yards capacity. For each grab, overlying water was drained prior to depositing the sampler's contents into the collection container. Composited material was then homogenized using an electric 3.5 HP mixer (food-grade stainless steel shaft and propeller). The sediment was characterized by collecting 6 samples from random x, y, and z locations in the collection container after 30 minutes of mixing. The results of the analytical testing show an average coefficient of variation of about 15% for all of the contaminates. The analytical results for the pre-treatability study are contained in the appendix of this data report. Discrete sub-samples were removed into HDPE shipping containers lined with food-grade polyethylene bags, two of which were sent to BioGenesis for testing.

Sample containers were sealed immediately after filling and stored at ambient temperature for approximately 2 hours, at which time all containers were transferred to ice-packed shipping boxes. Sample labels and chain-of-custody forms were completed during sample container filling. Upon return to the Army Corps of Engineers Caven Point Terminal in Jersey City, NJ, shipping boxes were shipped via Federal Express, 2nd day delivery.[1]

On the evening of October 12, 1995, BioGenesis received via Federal Express, two five-gallon containers in two insulated boxes. Both boxes had damage visible from the outside, primarily to the bottom. Upon opening, the Styrofoam bottoms of the shipping containers in both boxes were destroyed, allowing the ice to melt and the liquid to leak out. Box one of two contained the Chain of Custody paperwork. This box was opened first and the temperature was recorded to be 20°C. Box two of two was then opened and the temperature was recorded as 20°C as well. Both five-gallon containers were placed in a clean, reconditioned 55-gallon drum with 200 pounds of ice. A small hole was punched in the side of the drum, just below the top level of the five-gallon containers so that water would not accumulate over the top of the buckets. The daily log for the samples is recorded below:

[1] Brookhaven-Rensselaer Environmental Partnership Memorandum, October 11, 1995.

Date	Activity, including time and temperature:
13 Oct.	Ice still present in barrel. Four bags @ 10 lbs ea. added. Time: 1515 hrs, Temp 3°C.
14 Oct.	Ice melted, warmer today. 120 lbs ice added. Time 1330 hrs, Temp 5°C.
15 Oct.	Plenty of ice around buckets. No ice added. Time 1815 hrs, Temp 2°C.
16 Oct.	Samples pulled from five-gal. buckets to check interior bags- both ok. 600g from bucket number one sent to Woodward Clyde via Federal Express for Hydrometer testing and sieve analysis. 60 lbs ice added. Time 1000 hrs, Temp 5°C.
17 Oct.	60 lbs ice added. Time 1530 hrs, Temp. 5°C.
18 Oct.	80 lbs ice added. Time 1640 hrs, Temp. 3°C.
19 Oct.	80 lbs ice added. Time 1600 hrs, Temp. 5°C
20 Oct.	80 lbs ice added. Time 1700 hrs, Temp. 4°C.
21 Oct.	100 lbs ice added. Time 1725 hrs., Temp. 5°C.
22 Oct.	100 lbs ice added. Time 1730 hrs., Temp. 6°C.
23 Oct.	80 lbs ice added. Time 1730 hrs., Temp. 6°C.
24 Oct.	100 lbs ice added. Time 1745 hrs., Temp 4°C.
25 Oct.	60 lbs ice added. Time 1730 hrs., Temp. 0°C.
26 Oct.	70 lbs ice added. Time 1730 hrs., Temp. 6°C.
27 Oct.	70 lbs ice added. Time 1530 hrs., Temp. 4°C.
28 Oct.	100 lbs ice added. Time 1500 hrs., Temp. 2°C.
29 Oct.	70 lbs ice added. Time 1700 hrs., Temp. 4°C.
30 Oct.	20 lbs ice added. Time 0600 hrs., Temp. 2°C.

Woodward-Clyde Consultants reported the particle size distribution and hydrometer analysis data. The complete results are included in the appendix of this data report. The sediment was reported to be 31.4% Fine Sand, 57.3% Silt and 11.3% Clay

On 30 October, the treatability test was conducted at the BioGenesis facility at 610 West Rawson Avenue, Oak Creek, Wisconsin. The activities began at 0700 hrs. to discuss the day's activities with the BioGenesis crew. Pumps were calibrated to deliver the appropriate amount of materials they were to deliver, the area was swept clean, chemicals were mixed and the equipment was setup and ready to begin at 1000 hrs. The weather conditions at 1000 hrs was 45°F, partly cloudy skies with the wind at 10 mph out of the SW.

At 1200 hrs, a health and safety meeting was conducted with all attendees. The subjects covered were the day's activities, potential contaminants and chemicals of concern in the area, emergency procedures including directions to the local hospital, and the process description to the attendees. Those in attendance and their function included:

Dr. Keith Jones, BNL Project Manager for the contract
Mr. Rob Klein, Assistant Quality Assurance Officer, BNL
Ms. Renee Haltmeier, Enviro-Tech Marketing
Dr. Mohsen Amiran, President, BioGenesis
Mr. Thomas Rougeux, Program Manager, BioGenesis
Mr. Mike Dubey, Operations Manager, BioGenesis
Mr. Tony Hoppe, Operations Technician, BioGenesis
Mr. Bijan Zandi, Production Manager, BioGenesis
Mr. Jason Wilde, Operations Technician, BioGenesis
Mr. Eric Kovatch, Natural Resources Technology

Natural Resources Technology (NRT), an environmental consulting firm from Pewaukee, Wisconsin, was subcontracted by BioGenesis to provide professional sample collection and data management. Sampling points and procedures were designed and executed by Mr. Eric Kovatch of NRT. Mr. Kovatch has 5 years of experience in environmental and hazardous waste management and consulting and he is a registered Professional Geologist in Wisconsin (P.G. #279). He has a Masters Degree in Hydrology from the University of Idaho and has worked extensively throughout the United States. His experience includes a wide array of projects including management of several manufactured gas plants and industrial sites, proposal preparation, investigation budgeting, drilling supervision, groundwater monitoring well installation and sampling, and data collection and analysis. Sites investigated include RCRA and PECFA (the Wisconsin US program) sites, US military installations (under the auspices of the US Army Corp of Engineers and US EPA), and private industry and railroad sites with soil and groundwater contaminated with petroleum products, chlorinated organics, RCRA metals, PCP, dioxin/furan compounds, and coal gasification by-products.

The equipment used during the bench test included the following:

- 55-Gallon capacity pre-treatment slurry tank with air-powered Lightnin Mixer motor, food-grade stainless steel shaft and propeller.
- 125-Gallon capacity BioGenesis℠ Sediment Washer with air-powered Lightnin Mixer motor, food-grade stainless steel shaft and propeller, pressure and slurry feed ports.
- 2" Wilden Sandpiper air diaphragm pump.
- 36" Rosedale Bag Filter with 1.5" air diaphragm pump.
- Setra Super Count high resolution counting scale (1.00g increment).
- Glasco GUS-15 Ultraviolet Water Purifier.
- HYDROX 1200 water treatment system.
- NLB 1012D-IN water blaster.
- 1" Wilden air diaphragm pump.
- 55 Gallons of BG-Decon Industrial Cleaner
- 5 Gallons BG-S-N2
- 1 Gallon BG-S-N3
- 5 Gallons sodium sulfide precipitate solution
- 1 Gallon Nalco Polymer
- 10 Gallons 50% Solution hydrogen peroxide
- JWI 3" J-Press filter press
- P141 Enerpac Hydraulic Compressor w/ #10112512 filters
- 5 Gallons BG-Clean 1103N Wastewater Odor Treatment
- SKC Model 223-3 Low Flow air monitor with SKC 226 charcoal tubes

At 1225 hrs. the samples to be treated were opened in the presence of all attendees and the temperature taken as 4°C. The samples were weighed and opened. A tank-bottom-like consistency with a heavy petroleum odor characterized the sediment material to be cleaned. Sample NC951011-11 contained a net weight of 17.138kg of material used in the treatment process. The sample was split into two five-gallon buckets to which one-half gallon of water was added to each bucket to facilitate screening of gross oversized material. The material was homogenized with a stainless steel trowel and poured through the screen into the pretreatment slurry tank. An archive sample of the material weighing 0.487kg was retained for BioGenesis' custody.

At 1246 hrs, sample NC951011-12 was weighed and a net 18.161kg of sediment material was split into the two five-gallon buckets to which one-half gallon of water was added to each to

facilitate screening of the gross oversized material. Again, the material was homogenized with a stainless steel trowel and poured through the screen into the pretreatment slurry tank.

1307 hrs.: One gallon BG-S-N2 and one gallon BG-S-N3 were added to the pre-treatment slurry tank and the slurry tank mixer turned on. The slurry mixture was agitated for a period of two hours to allow the BioGenesis chemicals enough time to mobilize any inorganic contaminates in the sediment. BioGenesis' information regarding the sediment characteristics, including potential contaminate concentrations was limited to the data in Tables 1 through 6 found on Page 8-13 in the Statement of Work contained in the RFP. For this reason, BioGenesis believed it prudent to optimize the residence time of the organic mobilization chemicals.

From the pre-treatment slurry tank, the slurry was pumped into the BioGenesis℠ Sediment Washer's collision chamber. This process took two minutes to complete after which the slurry was returned to the slurry tank where 50 ml of antifoaming agent were added. The cycle was repeated whereupon the slurry was again pumped into the collision chamber for cleaning. After the two minute cycle was completed, the slurry was returned to the pre-treatment tank for post treatment consisting of defoaming, dewatering and water treatment.

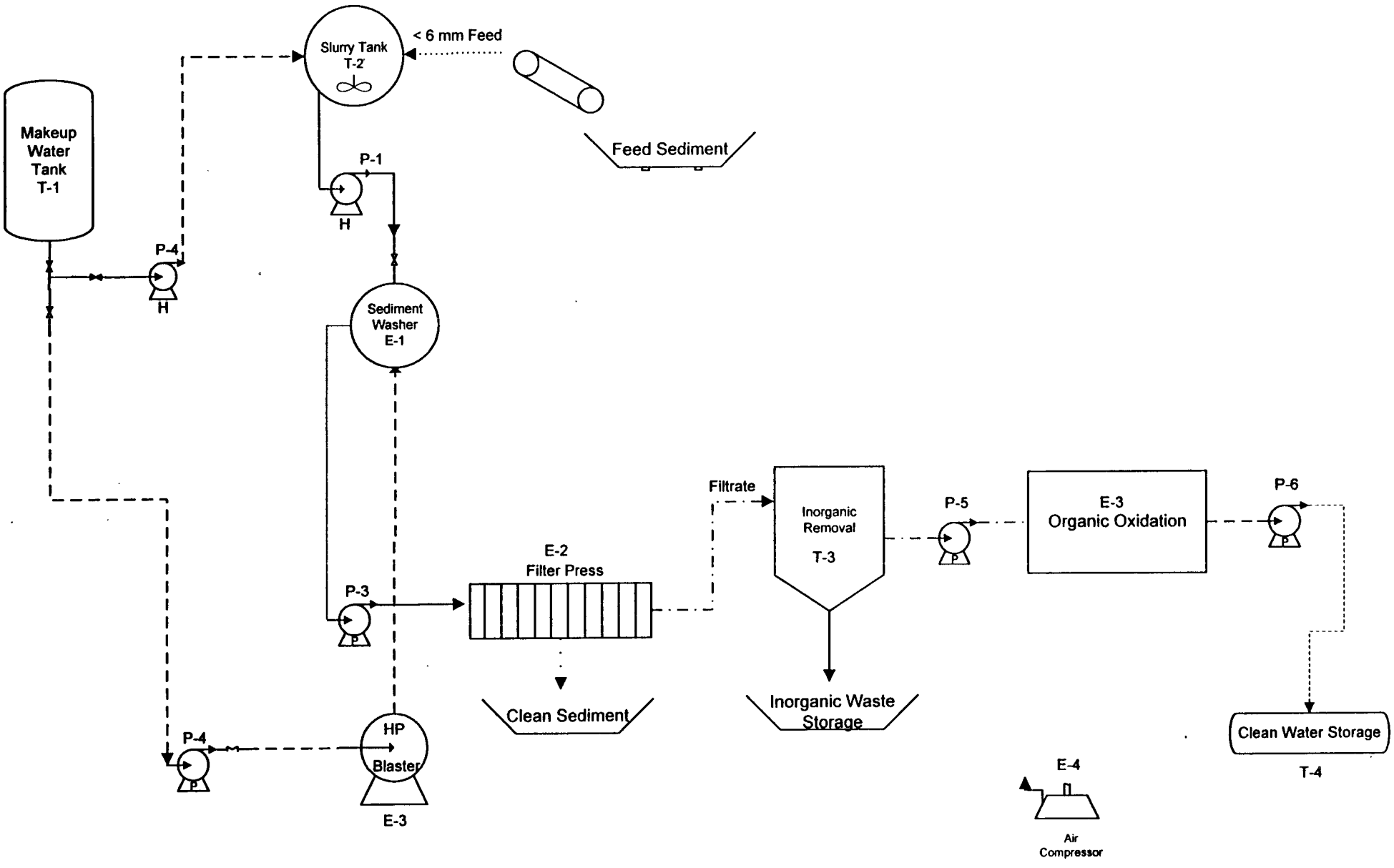
During the bench-scale treatment process, a total of 22 gallons of water was used in the collision chamber averaging 11 gallons of water per cycle. After the slurry was returned to the slurry tank the second time, 10ml of polymer combined with 500ml water was added to flocculate the slurry as a dewatering aid. The air mixer was turned on for two minutes to properly combine the dewatering aid with the sediment.

An air diaphragm pump was used to transfer the cleaned material to the filter press. After 15 minutes of filter pressing, the first dewatered "biscuit" of decontaminated sediment was presented to Brookhaven personnel at 1705 hours. At approximately noon the next day, BioGenesis had pressed the entire quantity of solids producing approximately 21 kg of cleaned material and 27.5 gallons of filtrate. The filtrate was processed by pumping the liquid through the HYDROX 1200 cavitation unit.

The air monitoring device was placed at the top of the pre-treatment tank for a period of two hours during which all tests were run on the sediment. The analytical results of the air monitor

indicated that no air emissions were detected during the treatability study. The analytical results for these tests are included in the appendix to this data report.

Chemical samples of each chemical used in the treatability test were taken by BNL for matrix spike analysis. The results of these analysis were not available for this report at the time written. The process flow diagram for the bench-scale treatability study is included on the following page:



Solids and Liquid Process Flow

Hydraulic, pneumatic, electric flows excluded.

BioGenesis℠ Soil and Sediment Washing, BREP Bench Testing

Reviewed by: C. Wilde, 2/6/96

Contaminated Soil ..... Clean Solids . . . . . .
Contaminated Slurry ——— Clean Water — — — — —
Contaminated Water — · — · — · —

III. MASS BALANCE

BioGenesis attempts to obtain a 3:1 ratio between the water and chemical solutions used to the sediment cleaned. This ratio has proven effective as a reasonable means to both achieve cleaning effectiveness without creating an overly large volume of water/effluent to treat and provide enough fluency to the soil/sediment mixture to permit pumping through the system.

The following represents the mass balance of materials used in the treatment process:

	Sample ID No.	
Step/Phase	#11	#12
Gross weight of sediment & container:	19.106 kg	20.157 kg
Less: weight of bucket and sample bag:	- 1.968 kg	- 1.996 kg
Equals: sediment available for demo:	17.138 kg	18.161 kg
Less: archival sample for BioGenesis:	- 0.487 kg	0
Equals: sediment for processing:	16.651 kg	18.161 kg

TOTAL sediment mass:		34.812 kg
Less: residual in buckets:		-0.270 kg
		34.542 kg
Less: oversized twigs, glass & gravel ≥6 mm:		-0.692 kg (2.00% oversize)
Equals: sediment actually processed:		**33.850 kg**

Water/chemical volumes added:

2 gallons water to facilitate screening:	7.558 kg
610 mL water, anti-foam & polymer:	0.610 kg
22 gallons wash water:	83.136 kg
Total added mass:	91.304 kg
Plus: sediment actually processed:	33.850 kg
Total mass of sediment and water/chemical solutions:	125.154 kg

Sediment Percentage of Total Mass:	**27.05%**
Water/Chemical Solution Percentage of Total Mass:	**72.95%**
	100.00%

The 3:1 liquids to solids ratio was met for the treatability study. It was noted during the bench process that the ratio of liquid to solid can be effectively lowered because of the ease of fluency of the sediment to be treated due to both the high water content of the sediment and its fine consistency. BioGenesis estimates that this ratio can be safely lowered to 2:1 in the pilot and full scale treatment phases if the sediment is treated in the same state as in the bench study. If the sediment is dredged and dewatered, the ratio is planned to be lowered to 2.50:1 in order to reduce the overall effluent from the system that must be treated. This ratio will be lowered by increasing the concentration of chemicals used, thereby reducing their volume, and reducing the volume of water used in the cleaning phase of the sediment within the collision chamber.

BioGenesis returned 7.1 kg of treated sediment to Brookhaven for testing, as well as liquid samples designated below:

Sample ID	Description	Volume
L-1	Liquid slurry after initial residence time	16 oz
L-2	Liquid supernate after flocculation	16 oz
L-3-7	Treated liquid effluents	16 oz each
S-1	Slurry after mixing, washing & polymer addition	16 oz
S-2	Treated end product (soil)	7.1 kg

BioGenesis collected 13.88 kg of treated end product for archival sampling and product demonstration. The effluent from the process was treated using hydraulically induced cavitation and ultraviolet radiation and peroxide to destroy organic contamination from the liquid.

IV. CHEMICAL AGENTS USED IN THE TREATABILITY TEST

The following information is provided to describe the non-hazardous and environmentally acceptable characteristics of all BioGenesis" S-series soil washing chemicals. These are the same ones that are used in the U.S. EPA Superfund Innovative Technology Evaluation program. As part of that evaluation, the EPA tested the physical characteristics of the chemicals themselves, and also tested the soil before and after using the chemicals. No detrimental factors were discovered. That evaluation is documented in Report EPA/540/R-93/510. BG-Clean" S-series Soil Cleaners are complex blends of non-ionic and anionic surfactants together with small amounts of additives for binding, enhancing biodegradation, color, and scent. The chemicals are designed as effective, safe, environmentally acceptable cleaners for use in any type soil. Specific

attention has been paid to ensure that the ingredients undergo rapid primary degradation in an active microbial environment. The product contains no known or suspected carcinogens under U.S. or German law (OSHA, ACGIH, NTP, IARC), hazardous substances (CERCLA), or extremely hazardous substances or toxic release chemicals (SARA Title III). The chemicals *do not contain phosphates*, nitrates, heavy metals, microbial cultures, nonyl phenol, or butyl cellosolve as ingredients. The product are classed as non-combustible.

The non-ionic surfactants in the cleaners are ethoxylated linear alcohols which undergo extensive, relatively rapid primary biodegradation. Neither variations in the alkyl chain length nor increments in the length of the ethoxylate portion of the molecule (within the range utilized) affect the rate of primary degradation. Studies indicate that the alkyl chain is degraded more rapidly than the EO chain with little dependence on the degree of branching but the primary branched chain ethoxylates are degraded more rapidly than 100% linear secondary alcohol ethoxylate. The EO chain is extensively mineralized (80 - >95%) with only a slight decrease in ultimate biodegradation up to 30 EO units. The major degradative pathway of alcohol ethoxylate appears to be oxidation of the alkyl chain and hydrolysis of the ether linkage. The poly-ethoxylate moiety of the alcohol ethoxylate molecule readily degrades to form lower molecular weight polyethylene glycols and ultimately, to CO_2, and water. The anionic surfactants in the chemicals are alkyl sulfates. Linear alkyl sulfates are readily biodegraded in standard BOD tests and $C0_2$ evolution procedures. Neither slight branching nor increments in the length of the carbon chain appear to exert a significant effect on the rate of degradation. Dieaway tests and simulated sewage treatment processes indicate complete primary biodegradation of these components within 1 to 3 days, even under anaerobic conditions. Biochemical oxygen demand tests on products in this family confirm rapid biodegradability. Typical results are as follows:

Day of Test	BOD (mg/l)	% Degradation
2	87,000	32
4	164,000	60
6	220,000	81
8	254,000	93
10	261,000	96

The proprietary additives for binding, enhancing biodegradation, color, and scent, each of which is less than 1% of the blend, are all food grade quality. The active ingredients of the chemicals have boiling points in excess of 200°C. Since the chemical is contained in an aqueous solution, the boiling point is lowered to just above that of water. Due to the miscibility of the active ingredients with water, the material does not have a measurable flash point.

BioGenesis is pleased to certify the following about BG-Clean" S-series ingredient's regulatory status in the USA:

- The products contain no constituents listed as Extremely Hazardous Substances in Superfund Amendments and Reauthorization Act (SARA) Title III §304, Emergency Notification: U.S. Code 40 CFR §355, Appendix A.

- The products contains no hazardous constituents as defined in SARA Title III Subtitle B, §311-312, Reporting Requirements: Occupational Safety and Health Administration (OSHA) regulations U.S. Code 29 CFR 1910.

- The products contains no toxic components listed SARA Title III Subtitle B, §313, Toxic Chemicals Release Forms: U.S. Code 40 CFR Subpart C, §372.

- The products contain no listed hazardous substances designated by the Comprehensive Environmental Responsibility and Cleanup Act (CERCLA); U.S. Code 40 CFR §302.4 in any quantity.

- Product ingredients are not subject to the Toxic Substances Control Act (TSCA) as provided in U.S. Code 19 CFR §12.121.

- The products contain no ingredients regulated by the Department of Transportation as DOT Hazardous Materials; U.S. Code 49 CFR §172.101, Hazardous Materials Table. The cleaner is classified as a Combustible Liquid, N.O.S., NA 1993, for shipping purposes, due solely to its flash point being between 93°C and 60°C.

BioGenesis' used its EAL℠ Process during the Brookhaven bench-scale treatability test. The EAL℠ chemicals consist of a blended acidic surfactant solution with an organic additive that

creates a complex specifically tailored to encapsulate heavy metals. The chemicals used are proprietary encapsulating agents designed to remove and stabilize the solubilized heavy metals, thereby making them more readily available for recovery. The BioGenesis process is not a conventional chelating process. The chemicals are used to mobilize and encapsulate the heavy metals in an aqueous solution to enhance the effectiveness of the surfactant chemical.

The BioGenesis EAL℠ Process works by utilizing the acidic effects of the proprietary surfactant solution to mobilize heavy metals from the solid particles. The organic complex is used to encapsulate and stabilize the heavy metal cations in solution, thereby making them available for the precipitation process. The use of these organic enhancers, coupled with the proprietary acidic surfactant results in a much higher removal percentage of heavy metals from any solid phase material than would otherwise be accomplished by acid extraction or leaching. In many cases, the enhancement can be from 10% up to 70% over acid extraction or leaching processes. The BioGenesis S-N2 and S-N3 chemicals which made up the EAL℠ solution used during the treatability test have the following characteristics:

S-N2 makes a strong, complex hydrogen bond with organic petroleum-based materials. The affinity of this chemical for halogenated organic materials such as PCBs, dioxins, etc., is much greater than the sediment's affinity for such products. Because of the greater affinity of S-N2 to the contaminates than the soil, S-N2 is able to clean soil and sediments by "pulling" the organic material out of the soil matrix.

S-N3 is a complex organic acid which is able to form very stable complexes with mono, di, and tri-valence cations. The capability of this chemical to bind with the cations is, in many cases, stronger than the normal amin-based chelating agents. However, the separation of metal from this complex acid is achieved much easier than from amin-based chelating agents such as tetra-ammonium EDTA.

Because it is an organic complex acid, S-N3 becomes a competitor with the humate substances in the soil for forming cationic complexes. BioGenesis' internal research indicates that humate substances act as a natural remedy for heavy metals by a process similar to stabilization. Nature attempts to prevent heavy metals from contaminating the ground by absorbing as much metal as the specific humate characteristics allow. This natural process is effective in helping to reduce the TCLP of heavy metals, however, total inorganic contamination is not reduced, it is simply

absorbed and held in place for a indeterminable amount of time. S-N3 is quite similar to the humate acidic substances which occur naturally to control heavy metal mobilization.

BioGenesis' approach to optimizing the proprietary chemicals S-N2 & S-N3 requires an adjustment to the chemical concentrations in solution to overcome the competing complex formations of humates with heavy metals. Simply beginning with "full" concentration is counterproductive to inorganic removal and is analogous to anti-freeze which freezes at "full" strength, but provides freezing protection at a diluted percentage.

V. END PRODUCTS PRODUCED BY THE TECHNOLOGY

The BioGenesis℠ Soil and Sediment Washing Process produced four end-products as a result of the treatability test. These end-products included: clean soil, clean sediment, inorganic-contaminated wash water and organic-contaminated wash water. These end-products were safely and easily managed within the system.

Clean soil was comprised of a 692 gram archival sample of glass, twigs and debris that was not treated in the process. The sample to be cleaned did not contain enough oversized material (+ 6mm) to perform a soil washing treatability test and therefore was hand washed afterwards and retained as archive sample. The treated sediment samples were delivered to Brookhaven representatives and BioGenesis' independent laboratory for cleanup verification. After verification, the entire quantity of cleaned soil and sediment was distributed as either archival sample or demonstration sample to BioGenesis representatives. BioGenesis has provided information to Brookhaven regarding the beneficial, economic use of the cleaned sediment as capping material for ocean disposal, backfill for construction projects, replacement for topsoil erosion, cover for landfills or a myriad of other potentially valuable uses. The BioGenesis℠ Soil and Sediment Washing Process is a true cleaning (vice volume reduction) technology producing reusable soil and sediment and manageable end products. The inherent characteristics of the sediment material were not altered by the BioGenesis℠ Soil and Sediment Washing Process. This end product sediment is a resource, as it is highly suitable for a variety of uses.

V. a. Clean sediment

The end product of clean sediment had a good soil/sediment quality in terms of compactness and structure. The strong petroleum odor was conspicuously absent from the sediment after treatment and had a pleasant, organic-based odor and a dark, humate color. The sediment was sufficiently dried to crumble apart in the hand, but would retain its shape if compressed by hand. The oily, grey sheen present in the pre-treatability sediment sample was no longer present and the returned sediment appeared to be rich in organics and suitable for a variety of beneficial uses.

V. b. Water: organic

The filtrate and supernate collected during the treatability study were very dark and oily in color and had a distinctly hydrocarbon odor. Empirically, the contaminates from the sediment appeared to have been transferred to the liquid phase, indicating reasonable cleaning efficiency on the sediments. The water phase quickly separated into two phases with a very viscous, dark greyish muck floating on top of a straw-yellow colored, transparent liquid.

Wash water contaminated with organic constituents was processed in the system by destroying the contaminants using hydraulic cavitation and UV oxidation to destroy most organic contaminants in the water phase. This process used hydrogen peroxide and a ultra violet lamp, coupled with a hydraulic cavitation inducer to oxidize organic contaminants. This process yielded water for potential reuse in the treatability study which was essentially the same straw-colored liquid found on the bottom of the pre-treated water, but without the viscous, dark grey material floating on top. It was apparent that the floating material, assumed to be the contamination, was destroyed during the cavitation, UV oxidation phases of water treatment.

V. c. Water: inorganic

Inorganic wash water was not treated in the treatability study because the process that was to precipitate the inorganic constituents from the water (a hydrogen sulfide solution) was made ineffective by the addition of the Nalco polymer used as a dewatering aid. The charge created by the polymer was too strong for the relatively weak precipitating characteristics of the precipitate solution. Additionally, the BG-S-N3 chemical formulation was specially blended for the treatability study without sufficient knowledge of the inorganic constituents. This speciality blend

of cleaning chemical also contributed to the ineffective precipitation of the hydrogen sulfide solution. As BioGenesis reported in its QAPP for the bench-scale treatability study, since liquid/solid separation and water treatment techniques are regarded as known, standard technologies, these are secondary objectives to the bench process. The resulting water has been used in subsequent tests by BioGenesis to determine the optimum flocculating agent and precipitation agents for use at the pilot scale. The results thus far have indicated that precipitation or an ion exchange technology is recommended as the inorganic wash water cleaning technology of choice. Both will be evaluated further when more testing can be performed.

VI. ANALYTICAL TESTING RESULTS

Representatives from Brookhaven National Lab sent a portion of the 7.1 kg of treated sediment to Triangle Laboratory for analysis. For analytical completeness, BioGenesis forwarded a sample from our archival sample to ANAlab in Edison, NJ, to test Polynuclear Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbon (TPH), and Total Organic Carbon (TOC). Selected results from the Triangle analysis are included in Tables 1 and 2 on succeeding pages. Complete results and QA/QC data are included in the appendixes of this report. Key results from Triangle are contained on pages 19-21 and 51-53 of Appendix A. Key results from ANAlab are contained on pages 20-21 of Appendix B.

VI. A. Discussion of Results

The analytical results from the testing conducted by both Triangle and ANAlab are well correlated, despite differing presentation methods that are at the discretion of the laboratory. Unfortunately, the results from both laboratories are deemed inconclusive, and not sufficiently significant to draw meaningful conclusions regarding the efficiency of cleanup achieved at the bench scale. The primary factor leading to this assessment is that the level of contamination in the sediment was significantly lower than the PQL (Practical Quantitation Limit) of Method 8270. Instructive in this regard is the following extract from page 3 of the Triangle report:

> *... The quantitation limit for all analytes is half of the* ***low point of the initial calibration adjusted for sample mass, percent moisture, or dilution when appropriate. ... Any concentrations reported at a level below the quantitation***

> ***limit will be flagged with a "J" and should be considered estimated.*** (emphasis added)

The table below illustrates the inherent limitations of the test method when applied to extremely low levels of analytes. The table derives from pp. 19-21, and 51-52 of the Triangle report.

Triangle PAH Results Summary		
	Sample S2-1	Sample S2-2
Total number of "hits" excluding compounds detected in the blank	21	20
Number of "hits" above the PQL	3	2
Number of "hits" below the PQL, i.e. "J" quality estimates	18	18
Number of "hits" more than 50% below the PQL	12 of 18	14 of 18

To provide users with, at least, some insight to the analytes present below the PQL, estimated MDLs (Method Detection Limits) are established. These are machine calculated, theoretical values of the lowest level that a skilled technician can "see" on a given test, on a given instrument. The reliability of estimated values that are **below** the PQL decreases the further the estimated value is from the PQL. Again, the Triangle report, page 3, is instructive:

> *... The estimated detection limits reported are the average detection limits achievable over time on an instrument type. The actual detection limit for a given compound on a given day may vary from the estimate reported. ...* ***Below this point*** (the PQL) ***the calibration cannot be considered to be linear.*** (emphasis added)

Note that 66% to 78% of the "hits" below the PQL were more than 50% below the PQL. This is a high indication of unreliability of the value because instrument calibration below the PQL is not linear.

Table 1 summarizes the test results from two sample batches: untreated samples whose results were provide to BioGenesis by Brookhaven, and treated sample results from Triangle, Appendix

A. BioGenesis has not had the opportunity to review the QA/QC data associated with the untreated samples.

The results in Table 1 were summarized **before** BioGenesis reviewed the QA/QC data. The objective was to assess the results as a whole. The table shows extremely high variability and inconsistency in the data between samples and between untreated (Brookhaven provided results) and treated (Triangle results). Having reviewed the QA/QC data, BioGenesis believes that the reason for this is simply that the test method does not and cannot produce scientifically repeatable and reproducible results when applied to analyte levels so significantly below the PQL.

The sensitivity of the 8270 analytical procedure is also strongly affected by the method used for sample preparation. In this case, confidence in results is further decreased by two factors: the extraction amount increased from one ml to two ml and the five times dilution of the extraction by Triangle before analyses which resulted in a ten times (10x) overall dilution factor. This dilution factor significantly reduces the reliability of the data reported.

Because of the 10x dilution factor, the PQL for the Triangle tests was increased to 6,950 μg/kg and 7,057 μg/kg from a standard of 333 μg/kg. The difference between the standard and test PQLs is significant because it shows that while 8270 is **capable** of very low detection levels, in this case the PQL was adversely raised by the 10x dilution factor. Put another way, all but 2 of the 26 compounds in the "6 sample mean untreated" samples that are being used by BREP as the baseline levels of contamination are **below the PQL** of 8270 for the Triangle tests. Most are more than 50% below.

The lack of precision in the in the results of the Triangle testing is compounded by the lack of precision found by examination of the standard deviations of the test results in the "6 sample untreated mean". Here the standard deviations varied from the mean by from 8% to 76%. This

Table 1
PAH & SVOC Results Comparison

BioGenesis Enterprises, Inc.
Analysis of 10/30/95 Sediment Testing for BNL

PAHs & SVOC		Untreated			Treated Sample S2-1				Treated Sample S2-2				Sample Comparison		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Chemical	Units	6 Sample Mean Untreated	SD	SD as a % of Mean	Result	% Removal	Result Above or Below Untreated	% Change Greater than % SD	Result	% Removal	Result Above or Below Untreated	% Change Greater than % SD	Difference S2-1 & S2-2	Difference Greater than SD	Difference Magnitude to SD
Phenol	ug/kg	585	275	47%	371	36.5%	below	no	509	12.9%	below	no	-138	no	-0.5
3,4 Methylphenol	ug/kg	1,390	190	14%	510	63.3%	below	yes	1,267	8.8%	below	no	-757	yes	-4.0
Napthalene	ug/kg	2,729	207	8%	6,569	-140.7%	above	yes	3,908	-43.2%	above	yes	2661	yes	12.8
4-Chloroaniline	ug/kg	1,003	112	11%	386	61.5%	below	yes	508	49.3%	below	yes	-122	yes	-1.1
2-Methylnapthalene	ug/kg	2,304	187	8%	3,295	-43.0%	above	yes	2,076	9.9%	below	yes	1220	yes	6.5
Acenapthylene	ug/kg	1,289	115	9%	1,473	-14.3%	above	yes	587	54.4%	below	yes	886	yes	7.7
Acenapthene	ug/kg	1,042	90	9%	1,190	-14.2%	above	yes	712	31.7%	below	yes	478	yes	5.3
Dibenzofuran	ug/kg	1,172	112	10%	1,620	-38.2%	above	yes	1,062	9.4%	below	no	557	yes	5.0
Fluorene	ug/kg	1,389	128	9%	2,272	-63.6%	above	yes	1,392	-0.2%	above	no	881	yes	6.9
Phenanthrene	ug/kg	6,589	583	9%	10,552	-60.1%	above	yes	6,201	5.9%	below	no	4351	yes	7.5
Anthracene	ug/kg	3,702	582	16%	6,474	-74.9%	above	yes	4,325	-16.8%	above	yes	2149	yes	3.7
Di-N-Butylphthalate	ug/kg	1,227	369	30%	916	25.3%	below	no	527	57.1%	below	yes	390	yes	1.1
Fluoranthene	ug/kg	10,327	1,227	12%	13,644	-32.1%	above	yes	8,180	20.8%	below	yes	5464	yes	4.5
Pyrene	ug/kg	7,102	664	9%	11,243	-58.3%	above	yes	7,172	-1.0%	above	no	4071	yes	6.1
Butylbenzylphthalate	ug/kg	1,473	433	29%	164	88.9%	below	yes	192	87.0%	below	yes	-27	no	-0.1
Benzo(a)anthracene	ug/kg	4,484	458	10%	6,084	-35.7%	above	yes	3,858	14.0%	below	yes	2227	yes	4.9
Chrysene	ug/kg	4,564	565	12%	6,830	-49.6%	above	yes	4,823	-5.7%	above	no	2007	yes	3.6
Di-n-octylphthalate	ug/kg	3,523	2,670	76%	79	97.7%	below	yes	85	97.6%	below	yes	-6	no	-0.0
Benzo(b)fluoranthene	ug/kg	2,922	401	14%	5,384	-84.2%	above	yes	3,319	-13.6%	above	no	2065	yes	5.1
Benzo(k)fluoranthene	ug/kg	1,107	159	14%	1,861	-68.1%	above	yes	1,532	-38.3%	above	yes	330	yes	2.1
Benzo(a)pyrene	ug/kg	2,551	282	11%	4,089	-60.3%	above	yes	2,845	-11.5%	above	yes	1244	yes	4.4
Indeno(1,2,3-CD)pyrene	ug/kg	1,072	216	20%	1,485	-38.4%	above	yes	1,184	-10.4%	above	no	300	yes	1.4
Dibenzo(a,h)anthracene	ug/kg	377	141	37%	422	-12.0%	above	no	151	60.0%	below	yes	271	yes	1.9
Benzo(ghi)perylene	ug/kg	1,254	319	25%	1,220	2.8%	below	no	1,078	14.0%	below	no	141	no	0.4
Benzo(a)pyrene	ug/kg	2,126	264	12%	2,958	-39.2%	above	yes	1,767	16.8%	below	yes	1190	yes	4.5
Perylene	ug/kg	949	120	13%	2,615	-175.7%	above	yes	1,856	-95.6%	above	yes	759	yes	6.3
Total, 26 chemicals	**ug/kg**	**68,251**	**10,868**	**16%**	**93,707**	**-37.3%**	**7 19**	**4 22**	**61,114**	**10.5%**	**16 10**	**10 16**		**4 22**	

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S2-1 and S2-2 COMPARISON SUMMARY			
Contaminant Class	**S2-1 & S2-2 Results Consistent??**	**S2-2 Result Higher, Lower, or Same as S2-1??**	**Comment**
TOC	Yes	Same	Much higher than untreated
PAH	No	Inconsistent	Very large.
PCB	Yes	Same	
Dioxin & Furan	Yes	Higher	Inconsistent with pesticides
Pesticides	Yes	Lower	Inconsistent with dioxin & furan

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Table 2

Analysis of 10/30/95 Sediment Testing for BNL Dioxin, Furan, PCB, Pesticide Results

Totals Dioxins:	Units	Mean (Dirty)	Treated Sample S2-1 Result		% Removal	Treated Sample S2-2 Result		% Removal
TCDD	ng/kg	248.1	198		20.2%	230		7.3%
PeCDD	ng/kg	378.17	498		-31.7%	524		-38.6%
HxCDD	ng/kg	1370	1260		8.0%	1350		1.5%
HpCDD	ng/kg	4450	3190		28.3%	3490		21.6%

Total Furans:	Units	Mean (Dirty)	Treated Sample S2-1 Result		% Removal	Treated Sample S2-2 Result		% Removal
TCDF	ng/kg	2371.67	1300		45.2%	1400		41.0%
PeCDF	ng/kg	2853.33	2480		13.1%	2410		15.5%
HxCDF	ng/kg	5175	3080		40.5%	3380		34.7%
HpCDF	ng/kg	6085	4040		33.6%	4220		30.6%

PCB Totals:	Units	Mean (Dirty)	Treated Sample S2-1 Result		% Removal	Treated Sample S2-2 Result		% Removal
Mono	ug/kg	108.67	82.5		24.1%	75		31.0%
Di	ug/kg	379.33	210		44.6%	223		41.2%
Tri	ug/kg	727.63	391		46.3%	397		45.4%
Tetra	ug/kg	1588.33	999		37.1%	948		40.3%
Penta	ug/kg	1233.33	604		51.0%	585		52.6%
Hexa	ug/kg	808.83	427		47.2%	776		4.1%
Hepta	ug/kg	294.83	170		42.3%	172		41.7%
Octa	ug/kg	96	49.3		48.6%	55.4		42.3%
Nona	ug/kg	20.17	13.9		31.1%	15.5		23.2%

Pesticides	Units	Mean (Dirty)	Treated Sample S2-1 Result		% Removal	Teated Sample S2-2 Result		% Removal
Aldrin	ug/kg	75	7.3	*	90.3%	7.3	*	90.3%
4,4 DDD	ug/kg	162.1	128.1		21.0%	93.5		42.3%
4,4 DDE	ug/kg	150.57	95.3		36.7%	77.2		48.7%
Dieldrin	ug/kg	74.45	22.2		70.2%	15	*	79.9%

* Indicates result was less than the value shown.

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variability probably does not stem from lab or sampling errors. It is simply inherent in the fact that low analyte levels are being tested using the best method available, but nonetheless one which is less repeatable and reproducible the farther below the PQL and closer to the MDL that results are reported

A point about presentation of results--note the difference in the format of results presented by two laboratories, each qualified and certified, for the same method 8270 test. Triangle presents data that is apparently highly accurate as indicated by two decimal places for the concentrations and for the MDLs. ANAlab however presents MDLs with no decimal places and rounded to the hundreds. One could infer from this that Triangle was more accurate (or used a more precise test) than ANAlab. However such is not true because both labs used the same EPA test method with comparable equipment, procedures, and personnel. The explanation is that Triangle presented results **as they came from the machine**, while ANAlab presented results **interpreted for the level of precision** inherent in the analysis. In this case, for these samples, the level of precision is very low, and thus ANAlab, using legitimate laboratory discretion, reported MDLs rounded to the hundreds place, and again using laboratory discretion, chose to report potential hits below the PQL as non-detected instead of estimated values. Common practice says that in order for a "hit" to be considered "real" or significant, it needs to be three to five times the detection or quantitative limits. Triangle, on the other hand, reported machine results. The comparability of the two lab's instruments can be seen by the roughly comparable MDLs determined by both labs. Neither reporting method is right or wrong, although the argument could be made that Triangle's presentation gives the non-expert user a feeling of greater confidence than is warranted by the data. The overall lack of precision in the data is exactly why no conclusions can be reached for the bench testing.

In summary, the results of any analytical data can only be considered in light of the data qualifiers, detection or quantitative limits, and a statistically sound number or replicates. In this case, to give any confidence at all to results so close to detection limits, a minimum of seven samples would have had to be analyzed. Since QA/QC data is not available on any Triangle analyses of pre-treatability study samples, no comparison and therefore no meaningful conclusions can be reached with respect to statistically sound analytical results on removal efficiency. The inconclusiveness of the analytical data in no way can be interpreted to mean that removal did not occur. In fact, It is emphasized that examination of the products from the treatability test showed visible, tangible removal of petroleum by-products. Additionally, the BioGenesis℠ Soil and Sediment Washing

Process has proven effectiveness on heavily contaminated soils and sediments (Wastewater Technology Center, Thunder Bay testing). At this point in the BREP testing, we simply cannot use the data derived so far to assess effectiveness.

VI. B. Recommendations for the Pilot Testing

BioGenesis suggests running the pilot test on sediments which are more highly contaminated (for instance, concentrations which are several orders of magnitude above the PQL) which will produce results that will allow for effective cleaning efficiency evaluation. Using sediments with greater concentrations of contamination is analogous to differentiating between 100 pennies and 5 pennies rather than trying to distinguish between 100 and 103 pennies. By having the concentrations several order of magnitudes above the PQL, the evaluator can readily distinguish between clean sediment and not cleaned sediment.

The results of the pilot-scale study will also be greatly enhanced if an internal, BioGenesis analysis of the constituents of concern can be made beforehand. BioGenesis had requested results of the pre-treatment analyses of the dredged sediment in the QAPP, to assure complete optimization of the chemical formulas used in the treatment process. The results of the pre-treatability test analysis were not available in time for the bench test for BioGenesis to run chemical optimization batches on the sediment before testing. BioGenesis believes that this information is valuable and would have been greatly helpful on the optimization of the BioGenesis chemicals used and coordination with outside vendors of polymer and precipitation chemicals.

BioGenesis recommends a three-phase approach to solving this problem, one of which is a matrix spike analysis performed by the analyzing laboratory before running analytical results on cleaned soil. Another phase of the solution, to be performed before treatability testing, includes proper optimization and synchronization of all the chemicals used in the study. This second phase is a critical step in producing quality, reliable data on which decisions can be made regarding the effectiveness of the technology. The third phase involves a sampling and analysis plan that will include more highly contaminated material such that the removal efficiencies can be evaluated and a statistically valid number of replicates can be run to produce confidence levels on the order of 98-99%.

For the pilot-scale test, BioGenesis requests a fifteen-gallon sample of sediment (larger if possible) to evaluate two liquid-solid separation clarifiers to determine the best equipment for the project. This fifteen gallon sample will also assist BioGenesis in optimizing the EAL℠ treatment chemicals to be used in the process in the following areas:

1. Increase the number of samples available for testing to achieve statistically significant results.
2. Reduce residence time for mobilization of contaminates in the pre-processing phase.
3. Optimize cleaning efficiency per residence time.
4. Select the dewatering aid with proper ionic/anionic charge for maximum flocculation.
5. Optimize chemical compatibility with other vendor supplied chemicals such as the dewatering aid and precipitation chemical/process.
6. Odor control considerations at pilot-scale; e.g., is it desired? What BioGenesis odor control agents are suitable, etc.?
7. Select the correct filter media mesh size for both the dewatering filter press and the precipitation filter media.

The evaluation of inorganic contaminate recovery from the wash water will be an ongoing process for the pilot, full, and production-scale operations. It is BioGenesis' understanding that process of water conditioning is well understood by the water treatment industry and that the total treatment system for the harbor will involve several treatment methods and phases. BioGenesis will work with the post-sediment decontaminating vendor to facilitate an efficient design for the reuse of process water. For the pilot test, ion exchange and precipitation will be evaluated as the inorganic recovery phase of the process water conditioning. Vendors for this phase have been contacted and are being evaluated independently by BioGenesis. A recommendation for this phase will be submitted in the pilot-scale treatability study data report.

BioGenesis' optimization phase for chemical concentrations of S-N2 and S-N3 includes analyzing the clean product from test runs by GC analysis. By using the GC on both the chemicals used and the contaminates, we obtain a fingerprint of the contaminate, as well as the chemicals under different concentrations. By changing the chemical concentrations, as well as other physical parameters that affect the cleanliness of the soil, BioGenesis can optimize the soil cleanliness by

observations of the GC printouts with respect to minimizing the chemical fingerprint and maximizing the analyte reduction. The GC spectrum of the analytes in each case we measure will be recorded to obtain the highest quality results.

VI. C. Summary of Conclusions

Due to the level of contamination being lower than PQL, and because insufficient replicates were available, the spectral criteria generated during GC analysis did not meet reliability requirements, with numerous estimated values reported. Taken in the context of the inherent "false positive" bias setup of the analytical testing equipment, these factors prevent any meaningful conclusions from the bench testing to date.

BioGenesis proposes to obtain meaningful results during pilot testing by running matrix spike analyses before testing clean soil, by proper optimization and synchronization of all chemicals to be used in the study with the testing lab, by testing sufficient replicates to produce a 95% confidence level in results, and by conducting the testing on more highly contaminated material to provide improved discrimination between untreated and treated soil.

VII. BIOGENESIS' TECHNOLOGY IS SPECIFICALLY APPLICABLE TO DREDGED SEDIMENTS

The BioGenesis℠ Soil and Sediment Washing is a highly diverse and variable technology, the core of which utilizes chemistry driven solutions to many different problems. BioGenesis recognizes that remediation problems vary from site to site and has developed a technology that is equally adaptable to these problems. Because BioGenesis addresses the contamination from a molecular level and optimizes our proven, proprietary chemicals to mobilize the contamination, the technology is suitable for treating both organic and inorganic contamination in soils and sediments ranging from 2 inches to 100% clay.

The sample provided by Brookhaven was especially suitable for the technology in terms of sediment grain size and the ability of the material to flow through the system. Because the sediment material was dredged, has a high water content and has a relatively low abrasiveness, the Newtown Creek sediment is especially suitable for the BioGenesis process. The physical characteristics of the sediment reported in the SOW include an average 33% solids content for the fines material. This material is especially suited for efficient screening and pumping to the initial treatment phases of the process. The low abrasiveness is beneficial to the operation and maintenance of the process equipment. Pumps, hoses, mixers, and various equipment are less susceptible to breakdown when transferring the dredged sediments.

VIII. THE BIOGENESIS PROCESS IS CURRENTLY AT PILOT SCALE

The equipment that was utilized in the bench-scale test is readily capable of washing three to six cubic yards of material per day, depending on feed rate. At this capacity, a 25 cubic yard pilot-scale treatability test can be completed within a two week period. The entire project, including mobilization, shakedown, testing and demobilization can be accomplished within the one month time frame requested by Brookhaven.

Additionally, BioGenesis has a larger sediment washing unit currently stationed at the Naval Air Station, Alameda, California, that is capable of processing the entire 25 cubic yards in one day. Mobilization, Shakedown, Testing and Demobilization for this larger unit and accompanying material handling equipment can be accomplished in the one month time frame requested by Brookhaven. BioGenesis mobilized this equipment to the air station for the remediation of PCBs and lead in a sandy soil. The equipment has been fully tested and verified to run at a minimum of 75 tons per day.

For purposes of pilot-scale testing, it is recommended that the smaller sediment washing unit be mobilized with its smaller material handling equipment. This will accomplish the pilot-scale testing within the allotted month's time and reduce the amount of mobilization and treatment expenses required for the test. Using the smaller equipment will also reduce the utility and space requirements for the test, which is beneficial to the government.

VII. a. Alterations to the Bench-Scale Setup for the Pilot-Scale Study

BioGenesis used small, batch dewatering and water treatment equipment for the bench-scale operations. These equipments were listed in Section II of this data report. For the pilot-scale setup, BioGenesis plans to use a 50 gpm inclined plate clarifier, and a plate filter press for dewatering the sediment. This equipment will have the capability to properly integrate the polymer as a dewatering aid in line with the system flow. The inclined plate clarifier will operate in a continuous operation mode with the slurry water being fed to it at all times during operations. The clarifier will have a conical bottom which will feed the filter press on an as-needed basis, depending on the "bed" development of the sediment in the bottom of the clarifier which is important for its efficient operation.

The water treatment system used during the bench test included BioGenesis' 50 gpm HYDROX unit. The two UV reactors in the unit require 150 gallons of effluent to "charge" or fill the reactor vessels. Since the volume of effluent was known to be less than 50 gallons before the test, BioGenesis circumvented the UV reactors on the unit and processed the liquid effluent through the cavitation unit and then directed the liquid through a single-lamp, 2 gpm UV unit. During pilot-scale operations, the full functionality of the HYDROX unit will be used to destroy the organic contaminates from the liquid phase. The unit is properly scaled to handle the effluent rates of the system. Additionally, during the bench test, BioGenesis experienced difficulty feeding the HYDROX unit with such a small volume of effluent. The supply pump for the unit did not receive sufficient effluent through the system because of insufficient head pressure and restricted feed flow causing the supply pump to cavitate and air lock. This problem will be rectified at pilot-scale with the inclusion of an elevated 3,000 gallon supply tank to provide sufficient head pressure for the suction side of the HYDROX supply pump as well as a 3" suction hose versus the 1" used at bench scale.

VIII. PILOT-SCALE INFRASTRUCTURE REQUIREMENTS

For the 25 cubic yard pilot test, BioGenesis will require a prepared location to perform the test, similar to the location investigated in BioGenesis' proposal, Section XII. a. with the following space, personnel and utility services:

Operation area:	200' X 200'
Operators:	BioGenesis' Project Manager, Operations Manager, and three technicians plus customer supplied front-end loader and operator, technician and support crew (QA/QC, SHSO, etc.).
Electrical:	480V, 3ϕ, 250 amp service divided into three 30 amp circuits, two 25 amp circuits and two 50 amp circuits (one of which will serve as an 'extra').
Water:	100 gpm at 50 psi (minimum)
Office:	Phone, fax, and sanitary facilities

Other assumptions for the pilot-scale demonstration are that the material will have been screened to 6mm to remove oversize debris. BioGenesis assumes further that the material to be treated is of substantially the same consistency as the material treated during the bench-scale treatability

study. BioGenesis intends to pump the pre-screened material from the Brookhaven-supplied containment point directly into the BioGenesis pre-treatment slurry tank on an as needed basis until the entire 25 cubic yards of contaminated material have been treated. BioGenesis requests a confirmation of the type of system that will be used to hold the pilot-scale sediments as soon as this information is available.

IX. BIOGENESIS' PROCESS HAS LOW ENVIRONMENTAL IMPACT POTENTIAL AT PILOT SCALE

The set up and operational impacts of the BioGenesis℠ Soil and Sediment Washing Process are minimized by the design and function of the equipment and chemicals used. The equipment is designed to operate in a stand-alone environment and is uncomplicated and easily understood to facilitate public outreach. As demonstrated in the bench-scale study, no air emissions were detected above the pre-treatment slurry tank where exposed atmosphere mixing occurred for two hours.

Provisions have been accounted for in every detail of system configuration to minimize electrical requirements by using only 460V, 3ϕ service. Excessive noises are eliminated by using "whisper-quiet" air compressors; and diesel emissions from compressors and conveyors are controlled by operating machinery components only when necessary.

The sediment washer is totally enclosed throughput, continuous feed machinery. A high pressure pump and air compressor are the only source of undesirable noises in this process. The machinery is designed to occupy a minimal amount of space and is easily transported on one flat-bed truck. Current electrical requirement for both soil and sediment washing with full auxiliary equipment (dewatering, pretreatment, etc.) requires less than 250 total amp service. The processes are designed to operate with standard liquid-solid separation equipment including wet screens, hydrocyclones and clarifiers. Before and after treatment trains are easily integrated into both the BioGenesis℠ Soil and Sediment Washing Processes. Outside vendor supplied dredging, dewatering and stockpiling processes pose no unusual requirements for the technology.

The proprietary chemical formulations provided by BioGenesis for the remediation of hazardous sediments are completely environmentally acceptable and manufactured *Benign By Design*™.

The BioGenesis technology uses no hazardous processes that could create an environmental hazard, yet the technology has been demonstrated as powerful enough to handle the most demanding environmental applications.

The easily understood nature of the setup and operation of the technologies, coupled with the *Benign By Design*™ chemical formulations, provide straightforward permitting of the BioGenesis℠ Soil and Sediment Washing Process. Previous permitting procedures have involved dialogue with the appropriate permitting agencies and included information about BioGenesis Enterprises Inc., the proposed setup and operation parameters, as well as discussions regarding the disposal of end-products. Because of BioGenesis' involvement with the EPA's Superfund Innovative Technology Evaluation (SITE) program and the availability of reliable data from same, permitting has been forthright among all agencies and is expected to remain as such for the pilot-scale project.

In an effort to begin the permitting processes, BioGenesis has proactively sought input from the applicable permitting agencies including the City of Newark, NJDEP, the State of New York (State Division of Coastal Resources) and the U.S. EPA. These agencies have requested pertinent process information from BioGenesis regarding possible permit issues. At this point, no potentially adverse environmental impacts from the BioGenesis℠ Soil and Sediment Washing Process have been identified by the regulatory agencies. All agencies have indicated a willingness to dialogue and have demonstrated a cooperative spirit. BioGenesis continues to pursue the environmental impact and permitting issues on an ongoing, agency-by-agency basis.

X. POST TREATMENT MANAGEMENT REQUIREMENTS FOR ALL MATERIALS

BioGenesis recognizes the responsibility of proper disposal of all end products, residuals and debris generated during the pilot-scale project. To that end, we have made preliminary arrangements with a special waste hauler to accept the treated sediment, residuals and debris from the pilot study. The vendor has been secured on the assumption that the sediments to be hauled are characterized as presented in the SOW in the original RFP. The "before" pilot test analytical results performed on the pilot study sediments will replace the SOW analytical results as soon as they are available as an updated, preliminary result on the sediments. Once the "after" pilot test

results are obtained, these will become the characterization analyticals for the disposition of the treated soil. Other solid residuals, if any, will be appropriately characterized before leaving the site along with the liquid residuals pending disposition. Various New Jersey landfill operators have been contacted for preliminary acceptance. Initial indications are that the process required to properly dispose of the treatment residuals takes approximately 4-5 weeks. Additional indications are that the residual materials will be classified as a "Special Waste" and depending on the analytical results, will be classified as either "Hazardous" or "Non-Hazardous" and will be disposed of accordingly.

XI. ANTICIPATED EXPENSES FOR THE PILOT PROJECT

BioGenesis has submitted a detailed cost breakdown of material, labor and overhead required to perform the pilot-scale project. This data report confirms our pricing schedule, as previously submitted, is still valid. The details are included below as required under Section 5.2.2.7 of the SOW.

PROPOSAL BREAKDOWN
Pilot Scale Testing

March 9, 1995

RFP NO. 725024
Decontaminating Dredged Estuarine Sediments

		TOTAL
1. Material		68,330.00
2. Purchased Parts		71,985.00
3. Subcontract Parts		14,000.00
4. Tool Material		0.00
5. Purchased Tooling		100.00
6. Total Material & Parts (1-5)		$154,415.00
7. Material Handling (6 x 37)		23,162.25
8. Manufacturing D/L (29 x 33)		39,594.80
9. Tooling D/L (30 x 34)		0.00
10. Quality Assurance D/L (31 x 35)		2,556.12
11. Engineering Design D/L (32 x 36)		2,305.52
12. Other D/L		0.00
13. Total Direct Labor (8-12)		$44,456.44
14. Manufacturing Overhead (8 x 38)		5,939.22
15. Tooling Overhead (9 x 40)		0.00
16. Quality Assurance Overhead (10 x 41)		383.42
17. Engineering Overhead (11 x 39)		345.83
18. Total Overhead (14-17)		$6,668.47
19. Other Direct Costs		7,500.00
20. Total 6, 7, 13, 18, & 19		$236,202.16
21. General & Admin (G&A) (20 x 42)		7,086.06
22. Transportation		0.00
23. Total Cost 20, 21, 22		$243,288.22
24. Fee/Profit (23 x 43)		24,328.82
25. Facilities Capital Cost Money (FCCM)		0.00
26. Total Price 23, 24, & 25		$267,617.04
27. Quantiy		
28. Unit Price		
D/L Hours		
29. Manufacturing D/L		1,580
30. Tooling D/L		0
31. Quality Assurance D/L		102
32. Engineering Design D/L		92
Rates		
33. Manufacturing D/L		25.06
34. Tooling D/L		25.06
35. Quality Assurance D/L		25.06
36. Engineering Design D/L		25.06
37. Material Handling		0.15
38. Manufacturing Overhead		0.15
39. Engineering Overhead		0.15
40. Tooling Overhead		0.15
41. Quality Assurance Overhead		0.15
42. G & A		0.03
43. Profit Fee		0.10

APPROVED BY:

Date:

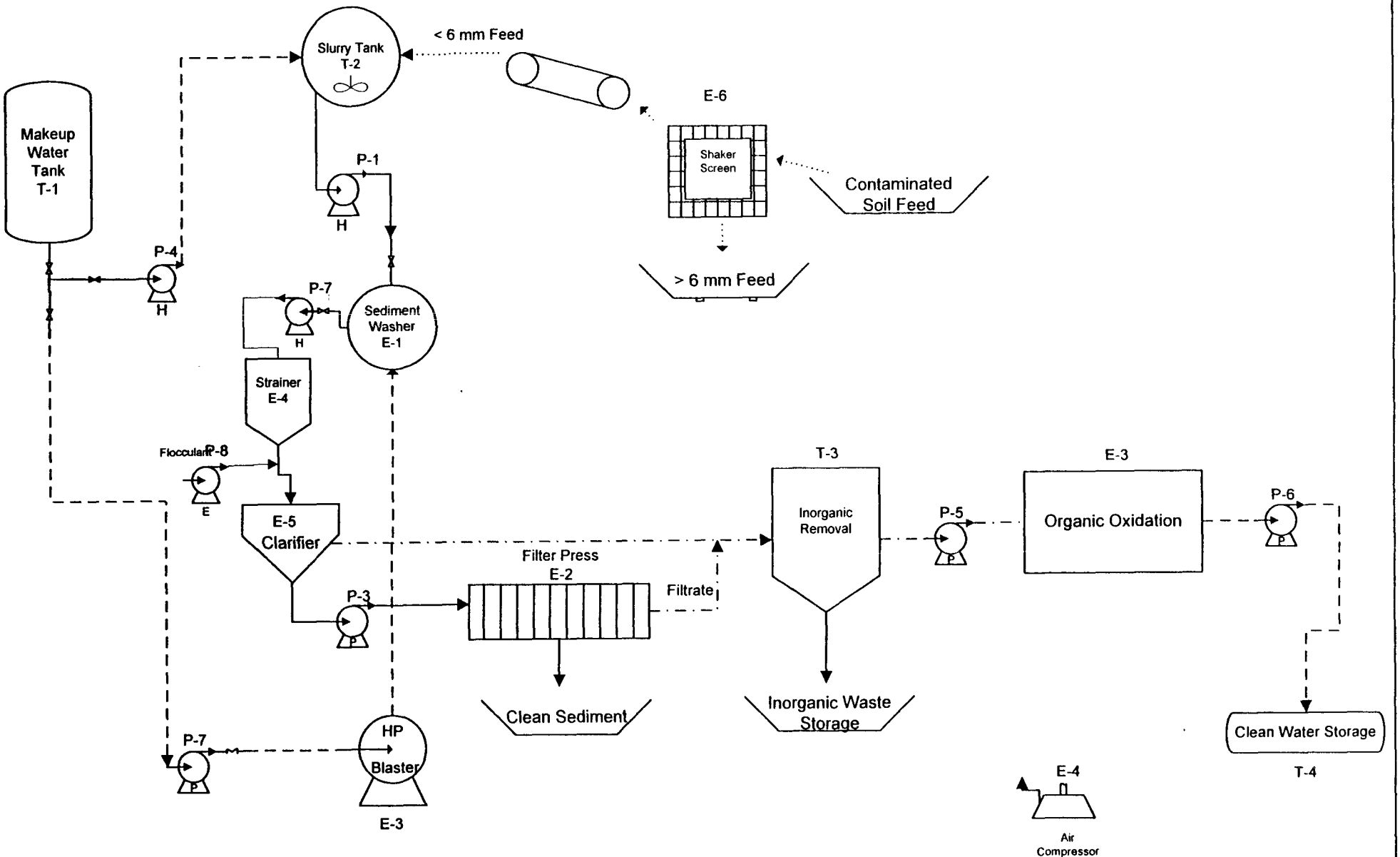
Charles L. Wilde, Vice President
BioGenesis Enterprises, Inc.

RFP NO. 725024 March 9, 1995 PROPOSAL BREAKDOWN
Decontaminating Dredged Estuarine Sediments **Pilot Scale Testing**

	MATERIAL	PURCHASED PARTS	SUBCONTRACT PARTS	TOOL MATERIALS	PURCHASED TOOLING	OTHER DIRECT
1. Planning and Precoordination						
a.QA/QC Plan Writing	50					
b.Permitting						
c.Disposal Arrangements						
2.Mobilization						
a Equipment						
i.Cleaning	20				100	
ii.Check-out						
iii.Packing						
iv.Moving Equipment						
(1)Crane			500			
(2)Trucks						
(a)Rental			6,000			
(b)Gas	1,000					
v.Setup						
(1)Electrical Installation	500		1,000			
(2)E Placement	500					
b.People						
i.Time						
ii.Airfare						
iii.Food						
iv.Housing						
3 Facility Preparation						
a.Electrical Install	500	3,000				
b.Set up						
4 Materials						
a.QA/QC Equipment						
i.Sampling trowles		20				
ii.Mixing Bowles		150				
iii.Mixing Spoons		45				
iv.PUF Cartriges		100				
v.Glassware		1,000				
vi.Metering, monitoring, measur		3,000				
b.Chemicals						
i.EAL Chemicals	18,000					
ii.Pr Minerals	2,000					
iii.Peroxide for UV/Oxidation	3,000					
iv.Sulfuric Acid	1,000					
v.Surfactants	20,000					
vi.Spiking Chemicals		5,000				
c.Consumables						
i.Filters		500				
ii.Vials, etc.		300				
iii.HPLC Water		500				
v.Lab Safety		500				
vi.PPE		3,000				
vii.Reporting Suplies						
(1)Log Books		50				
(2)Note Pads		30				
(3)Computer Disks		40				

5.Equipment Operation						
a.Equipment Rental						
i.Air pump for air monitoring		500				
ii.Screeners for soil and sedime		6,000				
iii.Compressors		1,500				
iv.Centrifuge		10,000				
v.Tanks		3,000				
vi.Container Filter		3,300				
vii.Conveyor		750				
viii.Automobile		2,000				
ix.Cellular Phone		1,800				
b.Soil Washer Use Fee	8,000					
c.Sediment Washer Use Fee	12,000					
d.Consumables						
i.Diesel						
(1)Compressor & generator	100					
(2)NLB pump	400					
ii.Visqueen		2,700				
iii.PPE		3,800				
iv.Quick-Detection analyticals		600				
6.Pilot Test Residual Disposal						
a.Solids						
i.Characterization		3,000				
ii.Treatment		3,000				
iii.Disposal		6,000				
b.Liquids						
i.Characterization		3,000				
ii.Treatment		3,000				
iii.Disposal	0					
7.Demobilization						
a.Equipment						
i.Cleaning	60					
ii.Check-out						
iii.Packing	200	300				
iv Moving Equipment						
(1)Crane			500			
(2)Trucks			6,000			
(a)Rental						
(b)Gas	1,000					
b. People time						
8 Reporting and Administration						
a.Sampling						
i.Procedure		500				
ii.Results						
b.Findings						
i.Validation of data						
ii.Report generation						
c.Scale up potential						
Total	68,330	71,985	14,000	0	100	0

XII. PILOT-SCALE SYSTEM PROCESS FLOW DIAGRAM



Solids and Liquids Process Flow

Hydraulic, pneumatic, electric flows excluded.

BioGenesis℠ Soil and Sediment Washing, BREP Pilot Project

Reviewed by: C. Wilde, 2/6/96

Contaminated Soil
Contaminated Slurry
Contaminated Water
Clean Solids
Clean Water

The above BioGenesis process flow diagram shows the proposed process flows for the sediment to be cleaned. The process begins by conveying the screened sediment into a slurry mixing tank where the sediment is homogenized with clean process water and BioGenesis℠ Cleaning Chemicals. After the sediment has become homogenized it is pumped into the BioGenesis℠ Sediment Washer where it is blasted with high pressure water from a water blaster and BioGenesis℠ Cleaning Chemicals. At this point the contamination is cleaned from the sediment and has become suspended in the process water.

After flowing through the BioGenesis℠ Sediment Washer, the cleaned sediment is treated with a polymer which helps to group the sediment and "drop out" the solids. The polymerized mixture is pumped to a clarifier where the cleaned solids settle out and the contaminated process water is pumped off and cleaned.

The settled solids are pumped from the clarifier to a pressure filter press where the residual moisture is removed and then pumped to the inorganic contaminant removal tank for cleaning. The cleaned solids are conveyed to a holding bin where they are made available for final disposition.

Process water from the clarifier and the filter press is next treated using standard water treatment techniques for the removal of inorganic contaminants. This process includes the addition of chemicals to settle out the contaminants and group them together. Once the inorganic contaminants have been settled and grouped, the process water is pumped through filters and then to ultra violet oxidation equipment where the organic contamination is destroyed. The cleaned process water is then pumped to a holding tank where it is tested and then recycled back through the system or disposed of into a sanitary sewer.

BioGenesis estimates that after the receipt of notice to proceed with mobilization for the pilot scale, the following schedule could be implemented and possibly shortened, depending on the specific requirements, advance notice of pending mobilization and any as yet unforseen permitting issues involved:

- Other vendor supplied equipment procurement (compressor, blaster, trucking, chemical production and base chemical procurement, liquid-solid separation, water treatment, etc.): - One Month Preceding Mobilization

- Equipment and personnel transportation
  -Six Weeks After Notice to Proceed

- Equipment setup and testing at pre-prepared site (electrical installation, water connections, bermed treatment area, office & sanitary facilities, etc.):
  -Seven Weeks After Notice to Proceed

- Pilot-Scale testing at an estimated three cubic yards per day:
  -Eight Weeks After Notice to Proceed

- Decontamination, demobilization and debris removal:
  -Ten Weeks After Notice to Proceed

XIII. CONCLUSIONS

BioGenesis offers an innovative technology for the decontamination of dredged sediments that has been previously proven to significantly reduce hazardous contamination from fine sediments. This data report for a bench-scale treatability report has detailed a testing instance where the analytical data received from the bench test proved inconclusive. BioGenesis believes this inconclusivity is highly indicative of three problems encountered with the test: 1) the inability of true camparisons to be made from before the test to after the test due to exaggerated variences in the data produced by the analytical testing, 2) the inability of BioGenesis to properly optimize the chemical concentrations and synchronize those concentrations with other vendor provided chemicals within the cleaning system, and 3) insufficient quantity of contaminates to provide an effective evaluation of the technology in this instance.

BioGenesis has provided a means whereby the pilot-scale testing will not be encumbered by these potential problems by proper optimization of all chemicals before mobilizing to the pilot project, performing the tests on sediments with contaminat concentration three to five times the practical quantitative limit for the analytes, thereby negating highly sensitive testing procedures which are overly suseptible to variations. BioGenesis has provided an unamended cost proposal for the completion of the pilot work which represents the best value to the government as a realistic and

immediately available significant contribution to a $21 billion dollar problem in the New York/New Jersey area.

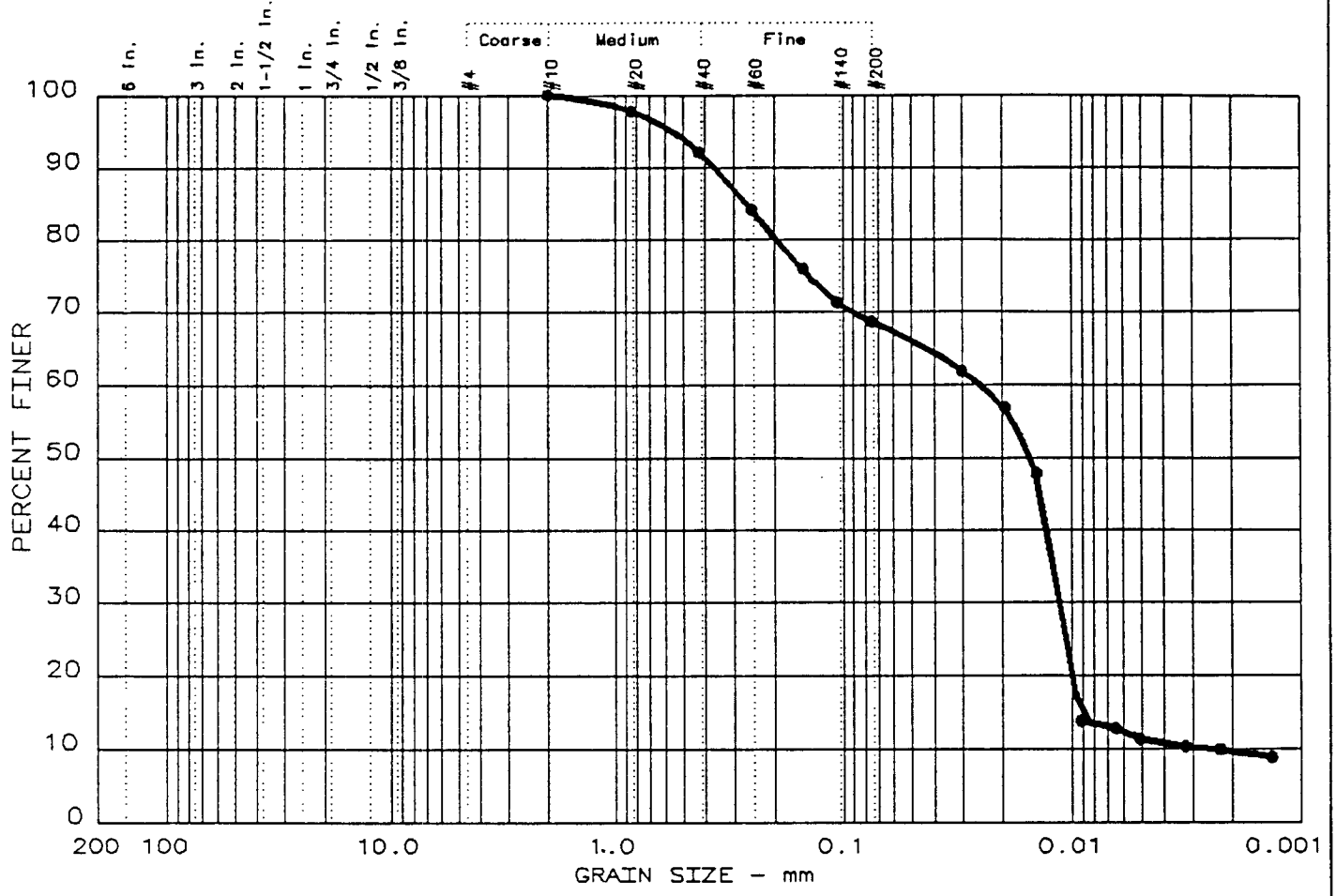
Although the analytical results of this particular test do not provide sufficient information, down stream potential problems have been clearly identified for the successful implementation of the BioGenesis℠ Soil and Sediment Washing Process.

APPENDIX A **TRIANGLE LABORATORY, INC. ANALYTICAL TESTING RESULTS** (Bound Separately)

APPENDIX B: **ANALAB, INC. ANALYTICAL TESTING RESULTS** (Bound Separately)

APPENDIX C: SIEVE ANALYSIS AND HYDROMETER TESTING RESULTS

PARTICLE SIZE DISTRIBUTION TEST REPORT



Symbol	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	0.0	0.0	31.4	57.3	11.3	ML	N/A	N/A

SIEVE inches size	PERCENT FINER ●		
	GRAIN SIZE		
D_{60} D_{30} D_{10}	0.01 0.00		
	COEFFICIENTS		
C_c C_u	2.20 11.2		

SIEVE number size	PERCENT FINER ●		
10	100.0		
20	97.8		
40	92.1		
60	84.1		
100	75.9		
140	71.3		
200	68.6		

Sample information:
● P.O. # 95101601
Black Sediment

Remarks:
TESTED BY: NL
CHECKED BY: GB

WOODWARD-CLYDE CONSULTANTS

Project No.: 5E05703-1
Project: BioGenesis

Date: OCTOBER 10, 1995 Sheet No. 1

GRAIN SIZE DISTRIBUTION TEST DATA — Test No.: 2

Date: OCTOBER 10, 1995
Project No.: 5EO5703-1
Project: BioGenesis

Sample Data

Sample Number: P.O. # 95101601
Sample Description 1: Black Sediment
Sample Description 2:
USCS Class: ML Liquid limit: N/A Plasticity index: N/A

Notes

Remarks: TESTED BY:NL CHECKED BY:

Sheet No.: 1

Mechanical Analysis Data

	Initial
Dry sample and tare=	49.44
Tare =	0.00
Dry sample weight =	49.44

Tare for cumulative weight retained= 0

Sieve	Cumul. Wt. retained	Percent finer
# 10	0.00	100.0
# 20	1.11	97.8
# 40	3.91	92.1
# 60	7.88	84.1
# 100	11.92	75.9
# 140	14.20	71.3
# 200	15.51	68.6

Hydrometer Analysis Data

Separation sieve is number 10
Percent -# 10 based on complete sample= 100.0
Weight of hydrometer sample: 50.17
Hygroscopic moisture correction:
  Moist weight & tare = 54.05
  Dry weight & tare = 53.56
  Tare = 20.48
  Hygroscopic moisture= 1.5 %
Calculated biased weight= 49.44
Automatic temperature correction
  Composite correction at 20 deg C =-3

Meniscus correction only= 1
Specific gravity of solids= 2.7
Specific gravity correction factor= 0.989
Hydrometer type: 152H Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
2.0	22.0	33.5	30.9	0.0131	34.5	10.6	0.0302	61.8
5.0	22.0	31.0	28.4	0.0131	32.0	11.0	0.0195	56.8
10.0	22.0	26.5	23.9	0.0131	27.5	11.8	0.0142	47.8
30.0	22.0	9.5	6.9	0.0131	10.5	14.6	0.0091	13.8
60.0	22.0	9.0	6.4	0.0131	10.0	14.7	0.0065	12.8
96.0	23.0	8.0	5.7	0.0130	9.0	14.8	0.0051	11.3
240.0	23.0	7.5	5.2	0.0130	8.5	14.9	0.0032	10.3
480.0	24.0	7.0	5.0	0.0128	8.0	15.0	0.0023	9.9
1440.0	22.0	7.0	4.4	0.0131	8.0	15.0	0.0013	8.8

Fractional Components

Gravel/Sand based on #4 sieve
Sand/Fines based on #200 sieve
% + 3 in. = 0.0 % GRAVEL = 0.0 % SAND = 31.4
% SILT = 57.3 % CLAY = 11.3

D85= 0.26 D60= 0.025 D50= 0.015
D30= 0.0113 D15= 0.00928 D10= 0.00228
Cc = 2.2004 Cu = 11.1558

APPENDIX D: AIR MONITORING ANALYTICAL RESULTS

Galson Laboratories

6601 Kirkville Rd.
East Syracuse, NY 13057

Phone: (315)432-0506
~~(800)950-0506~~
Fax: (315)437-0571

PRELIMINARY SAMPLE RESULTS

TELECOPY

NUMBER OF PAGES SENT (INCLUDING THIS COVER): 4

TO: Bob Klein % Tom

DATE: 10/31/95

COMPANY:

FROM: Nancy Ackerman

FAX: 414-571-6231

SUBJECT: results

MESSAGE:

HARD COPY TO FOLLOW: YES ✓ NO

IF THERE IS A PROBLEM WITH THIS TRANSMITTAL, OR IF YOU HAVE ANY QUESTIONS, PLEASE CALL (315)432-0506, EXTENSION 135. THANK YOU!

PRELIMINARY LABORATORY ANALYSIS REPORT

: Brookhaven National Laboratories
: Newtown Creek
mpled : 12-OCT-95 Account No.: 19163
ceived : 16-OCT-95 Login No. : L26321

p ID : L26321-1

	Air Vol l	Front ug	Back ug	Total ug	Lod ug	DE %
hane	NA	< 5	< 5	< 5	5	100
chane	NA	< 10	< 10	< 10	10	100
ne	NA	< 5	< 5	< 5	5	100
ne	NA	< 3	< 3	< 3	3	100
	NA	< 3	< 3	< 4	3	75
	NA	< 2	< 2	< 2	2	86
	NA	< 2	< 2	< 2	2	100
ride	NA	< 20	< 20	< 20	20	100
ide	NA	< 5	< 5	< 10	5	50
	NA	< 2	< 2	< 2	2	92
	NA	< 10	< 10	< 10	10	100
	NA	< 2	< 2	< 2	2	100
	NA	< 3	< 3	< 5	3	65
	NA	< 2	< 2	< 2	2	100
	NA	< 3	< 3	< 8	3	40
	NA	< 2	< 2	< 2	2	100
	NA	< 3	< 3	< 5	3	62
yl	NA	< 3	< 3	< 5	3	56
e	NA	< 3	< 3	< 3	3	91
ene	NA	< 2	< 2	< 3	2	72
Xylene	NA	< 2	< 2	< 2	2	85
Xylene	NA	< 3	< 3	< 4	3	80
	NA	< 3	< 3	< 3	3	90
	NA	< 3	< 3	< 6	3	53
	NA	< 2	< 2	< 2	2	100
	NA	< 3	< 3	< 3	3	89
e	NA	< 3	< 3	< 3	3	89
	NA	< 2	< 2	< 2	2	100
ne	NA	< 3	< 3	< 3	3	91
luene	NA	< 2	< 2	< 2	2	100
ene	NA	< 5	< 5	< 5	5	100
	NA	< 3	< 3	< 4	3	85
	NA	< 2	< 2	< 2	2	100
	NA	< 2	< 2	< 2	2	100
	NA	< 4	< 4	< 4	4	100

ntitation: See Above
ethod : NIOSH 1003
) : 10 ppm
dia : Charcoal

Submitted by: Jeremy Macie
Approved by : Mary Beth Wolff
Date : 31-OCT-95
QC by:

ng -Milligrams m3 -Cubic Meters kg -Kilograms
ug -Micrograms l -Liters NS -Not Specified
ND -Not Detected ppm -Parts per Million

t performed by Galson. Galson presents results based on sampling data

PRELIMINARY LABORATORY ANALYSIS REPORT

Client : Brookhaven National Laboratories
Site : Newtown Creek
Date Sampled : 12-OCT-95
Date Received : 16-OCT-95
Account No.: 10163
Login No. : L26321

Sample: #21 Lab ID : L26321-3

Parameter Name	Air Vol l	Front ug	Back ug	Total ug	Lod ug	Rs %
1,1,1-Trichloroethane	9.68	< 5	< 5	< 5	5	100
1,1,2-Trichloroethane	9.68	< 10	< 10	< 10	10	100
1,1-Dichloroethane	9.68	< 5	< 5	< 5	5	100
1,2-Dichloroethane	9.68	< 3	< 3	< 3	3	100
Acetone	9.68	< 3	< 3	< 4	3	75
Alpha-Methylstyrene	9.68	< 2	< 2	< 2	2	95
Benzene	9.68	< 2	< 2	< 2	2	100
Carbon Tetrachloride	9.68	< 20	< 20	< 20	20	100
Cellosolve Acetate	9.68	< 5	< 5	< 10	5	50
Chlorobenzene	9.68	< 2	< 2	< 2	2	92
Chloroform	9.68	< 10	< 10	< 10	10	100
Cyclohexane	9.68	< 2	< 2	< 2	2	100
Cyclohexanone	9.68	< 3	< 3	< 5	3	60
Cyclohexene	9.68	< 2	< 2	< 2	2	100
Ethyl Alcohol	9.68	< 3	< 3	< 8	3	40
Ethyl Benzene	9.68	< 2	< 2	< 2	2	100
Isobutyl Alcohol	9.68	< 3	< 3	< 5	3	62
Isopropyl Alcohol	9.68	< 3	< 3	< 5	3	56
M-Dichlorobenzene	9.68	< 3	< 3	< 3	3	91
Methyl Ethyl Ketone	9.68	< 2	< 2	< 3	2	73
Methyl Isobutyl Ketone	9.68	< 2	< 2	< 2	2	95
Methyl N-Propyl Ketone	9.68	< 3	< 3	< 4	3	80
N-Butyl Acetate	9.68	< 3	< 3	< 3	3	90
N-Butyl Alcohol	9.68	< 3	< 3	< 6	3	53
N-Hexane	9.68	< 2	< 2	< 2	2	100
N-Propyl Acetate	9.68	< 3	< 3	< 3	3	90
O-Dichlorobenzene	9.68	< 3	< 3	< 3	3	89
Octane	9.68	< 2	< 2	< 2	2	100
P-Dichlorobenzene	9.68	< 3	< 3	< 3	3	91
P-Tert-Butyl Toluene	9.68	< 2	< 2	< 2	2	100
Tetrachloroethylene	9.68	< 5	< 5	< 5	5	100
Tetrahydrofuran	9.68	< 3	< 3	< 4	3	85
Toluene	9.68	< 2	< 2	< 2	2	100
Vinyl Toluene	9.68	< 2	< 2	< 2	2	100
Xylene	9.68	< 4	< 4	< 4	4	100

Level of quantitation: See Above
Analytical Method : NIOSH 1003
OSHA PEL (TWA) : 10 ppm
Collection Media : Charcoal

Submitted by: Jeremy Macie
Approved by : Mary Beth Wolff
Date : 31-OCT-95
QC by:

< -Less Than mg -Milligrams m3 -Cubic Meters kg -Kilograms
> -Greater Than ug -Micrograms l -Liters NS -Not Specified
NA -Not Applicable ND -Not Detected ppm -Parts per Million

Field sampling was not performed by Galson. Galson presents results based on sampling data provided by clients.

Printed: 10/31/95 13:09